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The role of participatory watershed management practices for sustainable rural livelihood improvement in Handosha Watershed, Gibe district, Southern Ethiopia

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Abstract

The sustainability of environmental management practices such as watershed management intervention strategies relies on the understanding of the connection of the rural community's participation, and livelihoods. However, there have not been many efforts effort to document the relationship between watershed management and sustainable livelihoods. In line with this, the research has assessed the role of participatory watershed management practices for sustainable rural livelihood improvement in Handosha Watershed, Gibe district, Southern Ethiopia. To address the above objective, household survey, focus group discussion and key informant interview were employed to collect and analyze the data from 122 randomly selected households in four sub-watersheds. Descriptive analysis, independent t-test and chi-square test were applied to analyze the data. The result of the study indicated that the collective value of overall livelihood assets and the specific major components that encompass crop diversification, food availability, land productivity, and physical assets were better after watershed intervention than before watershed intervention. The key finding of the research presents that due to different interventions the livelihood of the community was diversified and enhanced especially; profits, soil fertility, crop productivity, forest, water and food availability become enhanced. Findings of the study suggested that further emphasis is needed to enhance the households' livelihood assets for sustainability of livelihoods. Local administrators and development agents need to recognize socio economic and topographic specific features as well as the constraints to involve society fully in various activities of participatory watershed management activities.

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Introduction

Sustainable livelihood improvement is a growing issue, particularly in the developing countries given the mounting challenge of poverty, low economic development and poor agricultural. Ethiopia is not an exception where the degradation of land resource base and associated decreasing land productivity have been a major challenge for the sustenance of livelihoods of people (Teklewold *et al.,* 2013). Agriculture is the economic mainstay of the overwhelming majority of people in Ethiopia and will continue to be the base for sustainable livelihood of the country (Gessesse *et al.,* 2016). However, the ongoing watershed degradation in the form of soil erosion and soil nutrient depletion is the threatening factor for agricultural development (Shiferaw and Singh 2010). The degradation of watershed has been associated with the interacting effects of biophysical and socioeconomic factors and exacerbated by rapid population growth which would be resulted in not only decreasing land productivity but also aggravate ecological degradation, hampered households' livelihood improvement and social development (Kerse 2018). In addition, much watershed conservation related research in Ethiopia is fragmented, focusing on biophysical (Taye *et al.,* 2015) and economic returns (Kassie *et al.,* 2011). Furthermore, a more specific conceptual framework that explains the nexus of the perception, community participation, and livelihoods to- wards sustained watershed management program is rarely found.

In response to the watershed degradation problems in the country, massive conservation, rehabilitation and afforestation movements were undertaken in Ethiopia (Engdawork & Bork, 2014; Tesfahunegn *et al.,* 2012). Furthermore, conservation measures had been regularly accepted by farmers aimed decreased soil erosion, increased soil fertility and safeguarding the soil long-term productivity (Moges & Amsalu, 2017) and achievements in food security, poverty reduction and ecological sustainability (de Graaff *et al.,* 2008; [Teshome *et al.,* 2016). The acceptance of watershed management practices has been considered as agricultural development policy. Farmers gain incentives from agricultural and international initiatives to invest watershed management practices (de Graaff *et al.,* 2013). However, the efforts couldn't bring perceived changes as expected (Teshome *et al.,* 2016). Consequently, this brought a low acceptance rate of some of these sustainable watershed management practices in the rural regions(Berresaw *et al.,* 2010) for its top-down approach (de Graaff *et al.,* 2013). As farmers were completely ignored from decision making in the selection, designing evaluation and implementation processes of watershed management practices

The conservation measures in place were also undertaken without farmer's interest and conviction. As a result, these drive the farmers to remove conservation structures following the change of food-for-work programs (Deressa *et al.,* 2009). Furthermore, there was little monitoring and assessment of the status of conservation measures and moreover, negligible maintenance for their sustainability (de Graaff *et al.,* 2013). On the other hand, failure conservation efforts emanated from the fact that was implementing agencies couldn't notice local level institutional, physical and socioeconomic realities (Enki *et al.,* 2001). Thus, it's vital to plan appropriate watershed conservation measures that are acceptable by farmers, require practical consideration of different socio-economic determinants affecting farmers' decision (Shiferaw *et al.,* 2009). Inadequate success in the acceptance of watershed management practices has been a problem as lesser willingness of farmers to implement watershed management practices (Moges & Amsalu, 2017; Teshome *et al.,* 2016).

Effective watershed management practices can be realized only when farmers believe and decide on the benefits of practices and are actively involved in the evaluation and implementation activities. The farmer's decision to use and manage natural resources highly depends on their perception of the landscape (Mekuriaw *et al.,* 2018b. In fact, farmers can modify the technologies to their real situations (Teshome *et al.,* 2016).

Their perception and participation also vary in space and individual households due to different interactive factors. Therefore, this research aimed to identify the roles of participatory watershed management practices for sustainable rural livelihood improvement in Gibe district, southern Ethiopia.

Materials and methods

Study site description

This study was conducted in Gibe district of Hadiya zone southern Ethiopia (Fig. 1). Its geographical location extends from 7° 35' 10" - 7° 50' 50" N latitude and 37° 32′ 5″ - 37° 45' 38" E longitudes. Total area coverage of the district is 44,780 hectares. The altitude ranges from 1500 - 2350 m.a.s.l.

It is characterized by diversified topography consisting of the undulating plains, high plateaus topped by hills and mountains, and river valleys. The major soil types include fluvisols in the gentler slopes and riverbank areas, whereas vertisols in the major lower slope positions. Rainfall distribution in Gibe district is bimodal, characterized by heavy rainy season from June to September (Kiremt), and small rainy season from March to May (Belg).

The mean annual rainfall ranges from 900 -1200mm, and the average annual temperature ranges from 15-28 oC. The district's major land use/cover classes include cultivated land, grassland, forest land, shrubland, built-up areas, and water bodies. Cultivated land is the dominant land use/cover type with 69.8% of the total area.

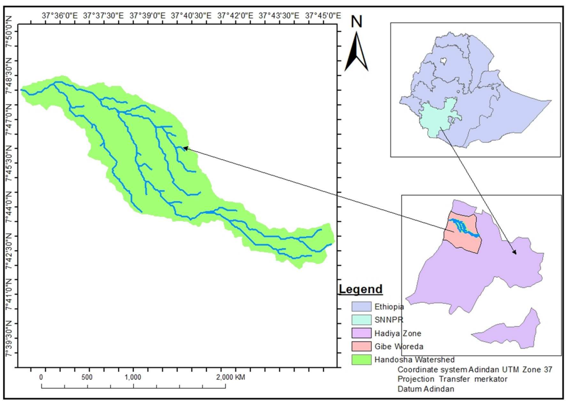

Fig. 1. Study area map.

Methods

Sources of data

The data used in this paper were gathered from both primary and secondary data sources. The primary data were collected from household heads, key informants who include community elders, chairperson, extension groups, development agents, watershed management work experts and officials and the focus group discussants that encompass community leaders, elders, development agents, experts and non-government actors involved in the watershed management program. The secondary data were collected from government's reports and available literature. The primary and secondary data were collected in order to cover every aspect of the study.

Sampling technique

The study was conducted in four sub-watersheds which were selected through multistage stage sampling procedures and a combination of purposive sampling and random sampling techniques. In the first stage, Gibe district was selected purposively based on its accessibility for transportation and communication. In the second stage, the identification of the sub-watershed was carried out in the transect walk with the help of maps developed by the development agents and district, and in discussion with local administrators, watershed management professional. Within this arrangement, four sub-watersheds such as Hergita, Qoxama, Wicheraro and Hombancho were selected purposively by using specific criteria, such as achievement of the activities which was evaluated based on time when the work started and observable evidences related to the performance of the watershed management activities.

In the third stage, list of household heads was obtained from farmer's training center (FTC) from each strata. It was selected because the considerable sources of information were obtained from, with regard to watershed management practices, and its effects on rural livelihood assets take place within the households. Various literatures such as (Tesfaye *et al.,* 2018; Alemu *et al.,* 2019) also used the same component of study in relation to watershed management.

Hence, the total numbers of household heads in the selected sub-watersheds were 731 out of which 731 were male and 100 were female. After that, household heads were stratified based on wealth in each sub-watersheds. Consequently, KIs were used to categorize all individual households in each selected sub-watershed into three main categories; rich, medium and poor, based on the sub-watersheds context.

There were a total of 731 households benefited from the watershed, out of which, 631 (86%) were male beneficiaries and 100(14%) of the beneficiaries were female headed households. Communities were varying with wealth status, which may have effects on watershed management practice.

They identified wealth criteria in the context of the rural community and it was found out that number of livestock, owned land size, and land with coffee and Enset crop possessed were the indicators of wealth in the communities' situation. From the total of 731 household heads living in study the area, 341 household were poor, 250 were medium and 140 were rich. Thus, the total sample size, 122 (from poor 57, medium 42, rich 23) household heads were randomly selected (Table 1).

In cases where selected household heads happened to be away from home for a long time or reluctant to be interviewed, randomly selected household were substituted for the missing household heads. Total sample size was determined by using the following formula (Cochran, 1977)

$$n_0 = \frac{z^2 pq}{d^2} \quad (1)$$

$$n = \frac{n_0}{1 + \frac{n-1}{N}} \quad (2)$$

Where; n_0 is the desired sample size when the population is greater than 10000 and n is number of sample size when population is less than 10000. z is 95% confidence limit i.e. 1.96 p is 0.09 (proportion of the population to be included in the sample i.e. 9%) q is 1 - 0.1 i.e. (0.9), N is total number of population, d is margin of error or degree of accuracy desired (0.05).

Table 1. Wealth class distribution of sampled households at sub-watersheds level.

Study kebeles	Total household		Selected sub-WS	Wealth class			Total sample HHs at sub-WS
	Frequency	%		poor	medium	rich	
Hamola	270	0.37	Hargita	21	15	10	46
Homecho	166	0.23	Qoxama	13	9	5	27
Danga	170	0.23	Wichararo	13	11	5	29
Halilicho	125	0.17	Hombancho	10	7	3	20
Total	731	1.00	4	57	42	23	122

Data collection tools

The primary data used in the study came from a detailed household survey, key informant interviews, focus group discussions and guided transect-walk observation. These primary data were supplemented with data from secondary sources which were gathered from reports and available literatures. The primary and secondary data were collected in order to cover every aspect of the study.

Household interview

Data collection instruments and development were carried out through a reconnaissance survey, discussions with experts and development agents, and a literature review. The survey was pre-tested with 20 randomly selected individuals (four from each village) who were not from sampled households. This was done after obtaining their permission to modify instruments to local conditions. Eight enumerators who were diploma holders and familiar with the culture and language of the local communities were selected and trained for four days for data collection. The questionnaires were translated into Hahiyisa which was the local language of the study area. This includes background information on the role of watershed management characteristics and challenges, community participation, watershed management practices and livelihoods of the households.

Key informant interview

The interviews with key informants were also used to capture data from them on a one-on-one source. This allowed the researcher to collect consistent and accurate data needed to achieve the research objectives. Information collected included the past and present condition of study area resources, SWC practices, and level of community participation in integrated watershed management activities.

Focus group discussion

In order to generate additional associated data, focus group discussions were made with the aid of prepared checklists. The discussions were intended to document local knowledge concerning past and present conditions of environmental resources, integrated watershed management practices, levels of community participation at different stages of watershed management activities, and its sustainability.

Transect-walk observation

The guided transect-field-walk observations were carried out, which allows for discussion among the participants during the walk and helps clarify unclear and well-known issues. The guided transect-field-walk observations across a given area were undertaken with the development agents and elders who were familiar and knowledgeable about environmental conditions and farming activities.

The willingness to accompany the researchers for the walk during which they had an opportunity to emphasize and support their responses with evidence on the existing environmental conditions

During the transect-field-walk observations, the researchers asked questions and paid attention to the explanations given by the participants, observed environmental conditions and made notes in the field notebook. The gathered information was used in supplementing the data from interviews and focus group discussions.

A transect-walk observation was made in the selected area to observe various soil erosion features such as watershed deterioration features and indicators, agricultural system and SWC practices. The livelihood characteristics and watershed management measures and their condition, vegetation cover were seen.

Data analysis

The descriptive data analysis included the frequency, percentages, means and standard deviations in order to explain and interpret the data obtained from sampled households. Content analysis was used to investigate the qualitative data collected using focus group discussions and key informant interviews. Besides, test of significance were computed using t-test to check association between continuous variables and Chi-square test to check relationship between food availability, crop diversification, level of participation, livelihood assets with watershed management practices. Statistical Package for Social Sciences (SPSS) version 24 was used for analysis.

Results and discussion

Socio-economic characteristics households

Farmers' socio-economic settings in different situations that affect the role of community based watershed management for community livelihood improvement in their landholdings. In this study, the demographic and socio-economic features of the sampled households were assessed and presented (Table 2).

The households are characterized as 86% males and 14% females and With regard to educational level, 51% households were illiterate while 49% were literate among which 27% can read and write, 26% was primary 1st cycle (1-4) and 18% was primary 2nd cycle (5-8).

About 15%, 45%, 49%, and 13% of the households' family size was in the range of 3–5 and 5-8, 8-10 an >10% members, respectively. Agriculture was the principal occupation for all of the households and only 34% of them are involved in other casual income generating activities (petty-trading, laboring, pastoralist, guarding, etc).

In terms of wealth status, almost equal proportions of HHs belong to poor (47%) wealth categories. The age of the sample households varies from 25 year to 70 year, with the average age being 48 years. From this, 14 (11%), 54 (44%), 44 (36%), and 10(9%) were in age between 25-40, 41-55, 56-70 and greater than70 year, respectively. The majority of the households' age is between 41 and 50.

This indicates that the mature households provide well contemplated response concerning the role of community based watershed management for community livelihood improvement.

Table 2. Household socio-economic characteristics.

Socio-economic characteristics		Frequency	percent
Sex			
	Male	106	86
	Female	16	14
Age			
	25 – 40	14	11
	41 – 55	54	44
	56 – 70	44	36
	> 70	10	9
Education			
	Illiterate	51	42
	Read and write	27	22
	Primary 1st cycle (1-4)	26	21
	Primary 2nd cycle (5-8)	18	15
Family size			
	3 –5	15	12
	5– 8	45	37
	8 –10	49	40
	> 10	13	11
Marital status			
	Married	99	81
	Widowed	9	7
	Unmarried	14	11
Occupation			
	Agriculture	81	66
	Agriculture and other	41	34
Wealth status			
	Rich	23	19
	Medium	42	34
	Poor	57	47

Impacts of integrated watershed management practices

The older farmers have less interest in practicing structural soil conservation on their fields. They couldn't make fanya juu, soil bunds and check dams as these require hard work which would not be easily accomplished by aged farmers. Then again, aged persons practice less labor demanding technologies such as simple cut-off drains, contour ploughing, planting grasses and use of other agronomic conservation measures. This suggests that older farmers use short-staying structures in their fields, which allow for more freedom of movement and smaller plots of land. Belachew, Mekuria, and Nachimuthu (2020) identified a negative relationship between acceptance farmers of conservation practices in relation to age. Regarding to the average age of households based on their acceptance category, farmers accept were 42.6 years old, while not-accept farmers were 49.97 years old. This result suggests that there is a statistically significant mean age difference between farmers acceptance of new conservation practices (t-value = 3.58, P = 0.000) (Table 3), showing that age has a significant relation with not acceptance of conservation. The results of the t-test show that there is statistically significant relationship between family size and acceptance category of the households (t-value =3.53, p= 0.001) (Table 3). Larger family size with more tendencies to prepare food rather than to participate in SWC will have negative effect on the practices of soil conservation measures. In relation to this, the study conducted by Bekele and Drake (2003)indicated that in the large families with greater number of mouth to feed, immediate food need is given priority and labor is diverted to off-farm activities that generate food items.

It was observed that cropland size and household acceptance category have a significant relationship (t-value =2.01, p=0.046) (table3). Farmers with larger holdings were more inclined to utilize conservation practices. This is because conservation structures take up some of the productive lands, and farmers with larger farms can more easily afford maintained structures than those with smaller farms.

The results of t-test shows that there is statistically significant relationship between farm size and acceptance of conservation practices (t-value =2.01, P=0.046 (Table3).

This implies that farmers with larger holdings had higher probability to apply conservation technologies. This can be attributed to the fact that conservation structures occupy part of the productive land and farmers with larger farm size can afford retaining structures compared to those with relatively lower farm size. Amsalu and Graaff (2007) similarly, found that farmers who have a larger farm land are more likely to invest in the soil and water conservation measures.

Table 3. T-test results, relationship between watershed deterioration and level of acceptance.

Variables	After WSM N= 88		Before WSM N = 34		t-value
	Mean	SD	Mean	SD	
Land size	1.43	0.74	1.12	0.84	2.01**
Age of households	42.6	9.89	49.97	10.84	3.58*
Family members	5.90	3.095	8.09	2.85	3.53*
Livestock holding	9.92	8.4	9.70	9.71	-0.12N

NS= Not significant, * and ** = Significant at 1% and 5% level, respectively.

Impact on crop production and income generation

The households survey indicates that crop production were much higher after the intervention compared to before intervention in the study area and average crop production and income of sampled households from crop production increased. According to the group discussants and interviews, the increasing in crop production and income were attributed to the watershed management activities like physical soil and water conservation which contributes to increased surface and groundwater availability, improved crop management practices like integrated nutrient and water management, integrated pest management and improved crop varieties adopted by the farmers in the watershed.

Impact on crop diversification

Table 4. Relationship between crop diversification and watershed management.

Crop diversification	Watershed Management						χ^2
	Total households		Before WSM		After WSM		
	frequency	%	Frequency	%	Frequency	%	
Diversified	79	64.8	9	30.0	70	76.1	
Not- diversified	43	35.2	21	70.0	22	23.9	
Total	122	100.0	30	100.0	92	100.0	21.04*

* Significant at less than 1% level WSM: Watershed Management

Great proportion of households perceived that introduced WSM enhanced crop diversification to be more profitable than the traditional ones. Hence, households made decision to retain SWC structures on their farm lands due to crop diversification. The continued use of IWSM showed attractive difference with diversification of crops. 64.8% of households indicated that the crop diversifications after IWSM were increased. On the contrary, 35.2% of households' perceive that it was not increased.

Chi-square test shows that there exists significant relationship between WSM measures and crop diversifications, (P = 0.000) (Table 4). The results shows that the proportion of households who stated that the WSM practices as profitable due to crop diversification.

Crop diversification is not only provides a wider option in production of various crops but, also minimizes risk and increases profitability besides connecting the maximum potential of land and water. Various factors like increased availability of institutional and infrastructural development, implementation of soil and water management technology, availability of improved varieties, availability of micro-financing and improved channel of rural marketing etc., are responsible for changes in crops and cropping pattern. Improved skills and awareness also give support to diversification of high value crops like vegetables. In the watershed, maize was the most diversified crop followed by wheat (Fig. 2).

Fig. 2. Crop diversification in the qoxama sub-watershed.

Impact on food availability of the households

Food availability of the households was improved due to the different conservation measures and application of improved agricultural inputs. As the survey data revealed, before the intervention 34%, 54%, 12% of the households harvest was able to cover the household's food demand for < 6, 6-8, 8-10 months, respectively. This indicates that more than 80% of the households were covered their food demand for less than 10 months from their harvest. However, after the intervention 6%, 58%, 20% and 16% of the households harvest was able to cover the household's food demand for < 6, 6-8, 8-10 months and full year respectively. This indicates that more than 60% of the households were covered their food demand for greater than 8 months from their harvesting. This indicates that the difference in food availability from harvesting before and after watershed management was significant (p=0.000) (table 5). From all these data, it is concluded that the implementation of watershed management practices improved the application of improved agricultural inputs and in turn increased household's productivity, income and food availability.

Table 5. Relationship between food availability and watershed management.

Food availability	Watershed Management						χ^2
	Total households		Before WSM		After WSM		
	frequency	%	Frequency	%	Frequency	%	
Available	78	63.8	11	36.7	67	72.8	
Not-available	44	36.1	19	63.3	25	27.2	
Total	122	100.0	30	100.0	92	100.0	12.82*

* Significant at less than 1% level WSM: Watershed Management

Impact on wealth status of the households

Wealth status of the farmers was mainly characterized by the number of livestock, the total area of land they owned and the food production status in the study area. Wealthy individual households in the study area were relatively involved in WSM practices. The survey results indicates that 46.7%, 34.4%, and 18.9% belong to poor, medium and rich households of the total sampled households living in the study area, respectively.

Table 6. Relationship between wealth status and crop diversification.

Wealth class	Total households		Crop diversification				χ^2
			Before WSM		After WSM		
	frequency	%	Frequency	%	Frequency	%	
poor	57	46.7	23	52.5	34	43.6	
Medium	42	34.4	13	29.5	29	37.2	
Rich	23	18.9	8	18.2	15	19.2	
Total	122	100	44	100.0	78	100.0	2.7***

*** Significant at less than10% level

The Chi-square test indicated that there is a significant association between wealth status and crop diversification (P = 0.09) (Table 6). This indicates that wealthy farmers have higher probability of practicing IWSM practices. As the result, crop diversifications of wealthy households were higher after watershed management than before the intervention.

This is in line with this result of Demelash and stahr, 2010 from a logistic regression analysis in central highlands of Ethiopia showed that wealth status of the households were important determinants of watershed management practices. Similarly, Jung *et al.* (2007) showed that wealthy farmers are known for being less uncertain regarding risks and for having a longer-term planning opportunity.

The survey result, in table 6 shows that high crop diversification have been observed from rich wealth class after watershed management. Previous to watershed management, the majority of households had limited crop diversification practices. The rich & middle households engage in more watershed management activities than the others of the sample households, and their farms grow a variety of crops.

Acceptance intensity of watershed management practices

The relationship between farmers' perception of watershed degradation, perceived outcomes of watershed management practices, farmers' participation levels and intensity of watershed management practices and livelihood enhancement was indicated in table 6 below. The computed Chi-square test value indicated that there was a significant association between intensity of acceptance of watershed management practices and perception of watershed degradation (Chi-square test = 7.76, p = 0.002); perceived socioeconomic benefits of watershed practices (Chi-square test = 82.24, p = 0.000) (Table 6); participation level in watershed management practices (Chi-square test = 122.813, p = 0.000); livelihood asset value (Chi-square test = 116.78, p = .000 (Table7). This implies that farmers' perception of watershed degradation, previous outcomes of the watershed management intervention and level of participation motivated farmers to participate in the acceptance of watershed management practices.

Table 7. Associations between perception, level of participation, livelihood assets and intensity of acceptance watershed management practices.

Perception level	Intensity of watershed management practice		χ^2	P-value
	≤ mean value	≥ mean value		
Perception on watershed degradation				
Lower(≤ mean value	46.6	28.9	7.76	0.002
Higher (≥mean value)	49.4	67.1		
Socio economic watershed management benefits				
Lower(≤ mean value)	67.0	14.4	82.24	0.000
Higher(≥ mean value)	29.0	82.6		
Participation level in watershed management				
Lower(≤ mean value)	81.9	17.9	122.81	0.000
Higher(≥ mean value)	16.1	79.1		
Livelihood asset value				
Lower(≤ mean value)	77.8	14.9	116.78	0.000
Higher(≥ mean value)	19.2	82.1		

* and ** = Significant at 1% and 5% level, respectively.

Community participation in integrated watershed management activities

The result of the field survey indicated that there were variations in involvement of the people in different activities of watershed development activities after intervention. The participation of farmers was found better in some selected activities of the watershed development such as participation on soil bund construction, planting trees around homesteads, planting grass and fodder on soil conservation structures, capacity building activities such as participating in training on how to implement activities whereas, it was found relatively low in some other activities such as, developing tree nursery establishment privately, income generating activities like modern beekeeping activities and soil fertility management practice like compost preparation (table 8). The overall farmers' participation during the implementation phases of watershed management practices was moderate level of participation which suggesting that there was less participation in some areas of activities.

This is in line with the study by Bagdi and Kurothe (2014) and and Guteta (2018) who found moderate overall level of people's participation in watershed management after intervention. This study conforms to the study by Tesfaye, *et al.* (2018), who found that respondent's participant more in watershed management activities than watershed management practices.

This might be due to exposure to information and training on environmental management. Results from interview and focus group discussion revealed that participation in some activities like tree nursery development and beekeeping were there, but require support and difficult to implement. This implies that there is a need to create awareness and support to ensure farmers' participation in a larger number of activities that ensure sustainable livelihood of households.

Acceptance of intensity of integrated watershed management practices

The intensity of acceptance ranged from zero to five practices (Table 4). There is also variation with regards to the intensity of acceptance of watershed management practices indicating that, while some farmers used up to five practices, there were still a few who used none of the five practices. However, the majority of farmers used at least two practices and the intensity of acceptance was low.

Table 8. Community participation in integrated watershed management activities.

Watershed management measures at implementation period	Frequency	Percent
Participation on soil bund construction	86	70
Slope side tree plantations	32	26
Participation on modern beekeeping work privately	28	23
Gully plugging by gabion	34	28
Gully plugging by brush wood check dam	73	60
Preparation compost on private land	36	30
Trench and micro basin development on hill side lands	67	55
Increasing tree nursery establishment for households	35	29
Development of waterways	43	35
Planting trees around homesteads	85	69
Planting grass and fodder on soil conservation structures	75	61
Development of cut off drains	54	44
Attending on capacity building training on how to implement activities	88	72
Horticultural practices (Planting fruit bearing trees- Orange, avocado, mango)	65	53
Planting multipurpose trees and management around homesteads	85	70

Observations through transect walk, focus group discussion and key informant interview also confirmed the same results, revealed that there is variation in the implementation of the watershed management practices.

Table 9. Acceptance of intensity of integrated watershed management practices.

Acceptance intensity of practices by households	Frequency	Percent
0	8	7
1	16	13
2	38	31
3	31	25
4	22	18
5	7	6
Total	122	100

Impact on employment opportunity and migration

Different watershed management practices were provokes households with different employment opportunity. The farmers in the watershed were well organized and increased working duration as far as they are convinced to get good return. Households were involved in trade and bee keeping activities and to start-up new businesses. Working culture of households was changed. The involvement of households in different activities reduced household's migration in the study area. The implementations of watershed management decrease migration through an increase in short-term employment as well as long-term productivity gains.

According to key informant's interview, from the study area farmers leave the area, and went to the Jima for long period of time to lead their livelihoods by engaging in daily labour. But after watershed intervention, migration was reduced due to livelihood diversification due to different types of daily labour activities. This finding is consistent with the study by Kumasi and Asenso-Okyere (2011), who stated that the indigenous practice of the local communities in Tigray state, including the study watershed provided free labour to restore ecosystems and the availability of community organizations and regulations were construction of check dams in Tigray, northern Ethiopia. The free labour, food for work, and cash-for-work programs and the household-level FSP program have been widely implemented in Ethiopia to mobilize local labour for conservation activities, to mitigate poverty, and to ensure food security. This enabled households to reduce the seasonal migration rates by providing better employment opportunities to the farmers.

Fig. 3. Diversified crops on the physical structures.

Impact on climatic hazards in the watershed area after intervention

The data from the group discussion and interview indicates that due to the different interventions implemented, there had been improvements in resource management and utilization in the study area and in turn reduced the impacts of climatic hazards. The survey results indicated that 72% and 20%, of households consider drought as moderate and less severe in the study area after the intervention. Whereas, 4.5% and 3.5% of households as very severe and severe, respectively. Almost all households confirm that the erosion hazards after intervention become less severe and they perceived its trend as decreased. The survey indicated almost all households perceived the climatic hazards in the study area after intervention as moderate and less severe. As discussed earlier households perceived the impacts of climatic hazards before intervention as very sever and sever but after intervention seeming as moderate and less severe.

Regarding to the status of main climate related hazards before and after the watershed management practices was discussed by focus groups; all focus group discussions assured that the impacts of main climate related disasters occurring in the study area were reduced due to the watershed interventions. This finding is consistent with Study by Berhanu., (2011), reported that the status of climate hazards like flood, drought, soil erosion and landslide in Choke Mountain in East Gojjam of Ethiopia were reduced and in decreasing trend due to the various watershed management practices. The physical soil and water conservation techniques were a greater contribution to increase fertility of cultivating land and crop production. Moreover, our field assessment showed that a significant volume of sediment was trapped behind the dams on the gully floor and that the space between structures was filled with sediment in most of the treated gullies.

As a result, the depth and width of gullies showed a significant decrease in 2016 compared with 2021 as seen in the partial view of repeat photographs taken during the respective periods. Hence, the gullied area was reclaimed and used for tree species production, such as fruit trees, grass, forage crop species and other multipurpose trees were planted (fig.4). This change is attributed to the impact of integrated conservation measures implemented on degraded lands and to gully-reshaping practices. Likewise, Yadav and Bhushan (2002) reported the importance of watershed management practices in gully re-establishment in India riparian areas. Study on the impact of watershed management practices on the sediment budget of watershed (187 ha), Nyssen (2009) reported that check dams were able to catch deposited sediment within the watershed.

Fig. 4. Unproductive land changed in to productive land.

Factors initiated households to implement conservation practices

Table 10. Watershed management impacts on common livelihood resource.

No	Change happen	Households' estimation in%		
		Moderate	Good	Very good
		≤ 25	25-50	≥ 50
1	Change in vegetation cover/land rehabilitation	7.3	59.2	33.5
2	Reduce runoff impact/Soil erosion	0	72.9	27.1
3	Moisture retention	7	76	17.0
4	Creation of village investment	35	55	10.0
5	Improved soil fertility	12.5	66.7	20.8
6	Change in capacity of spring/number	12	65	23.0
7	Change in ground water tables	29	52	19.0
8	Social relationship between community improved	12.3	54.2	33.5
9	Habits of working in groups improved	12	55	33.0
10	Knowledge on natural resource utilization increased	10.8	65	24.2

According to Woreda Natural resource sector report and focus group discussion a vast hectare of degraded and deforested land was covered by tree plantation after demarcation and protected from human and animal encroachment. Furthermore, 95% of the households were confirmed that vegetation coverage has been improved since they stared to participate on community mobilization for watershed management. For better estimation of change by the households, the investigators were categorized the levels of changes in vegetation coverage into three classes as Moderate (for changes ≤ 25%), Good (for 25%-50% change) very good (if ≥ to 50% change were observed). Accordingly, 59.2% of the households were estimated the change in vegetation cover as good. The remaining 33.5% and 7.3% were estimated the change as very good and moderate, respectively. The focus group and key informants were also stated that due to integration of in-situ moisture conservation structures with tree plantation, the survival rates of the planted trees, forages seedlings and grasses growth were improved.

This result implies that watershed management intervention was improved regular tree planting than non-intervention one.

The essential condition for the successful rehabilitation of the degraded land were the full participation of the local community at each levels from the planning stage to the implementation stage as well as the enforcement of local regulation established to protect the community's natural resources in the study area. The regulations have legal and political appreciation; thus, community members who violate the rule can be subject to sanctions. This finding is agree with the recent findings by Kumasi and Asenso-Okyere (2011), who observed that the indigenous practice of the local communities in Tigray State, together with the study watershed, of providing free labour to re-establish ecosystems and the availability of grassroots association .

The field survey revealed that, the indigenous plant species were increased due to high survival rate of seedlings in the enclosures areas. This study agreed with the results of a comparable study by Nyssen (2009), who reported that enclosures in the Mai Zeg-Zeg watershed showed an expansion of 100% between 2000 and 2006. The Bureau of Agriculture and Rural Development (2008) reported a survival rate of 90–95% for tree species in the study area, which is high compared with the survival rates 68% reported in a similar study conducted by Haregeweyn *et al.* (2012) in the Enabered watershed. The high survival rate observed in the watershed may be attributable to the rainfall, which is relatively well distributed and plentiful; the strong agricultural extension system; and diversified species selection. As assured earlier, most land escape of the study area were not commonly suitable for crop cultivation. However, farmers have still cultivating sloppy land by supplementing with mechanical conservation practices. As a result of conservation practices, gully reclamation, area enclosures and reforestation activities undertaken through the watershed management program, an improvement in soil depth has been observed in most of the sample watersheds.

The most common land management technologies that have been practiced in the watersheds includes: soil bunds, hillside terraces, deep trenches, check dams, diversion ditches and sediment storage dams. On the hillside landscapes, there were efforts to stabilize the conservation structures through tree planting, which also resulted in economic and ecological benefits. On cultivated areas, on the other hand, grasses and legume plants are widely used to stabilize and reinforce conservation structures. Soil fertility improvement measures, such as the use of compost and nutrient-fixing plants, are mostly used on cultivated lands. Key informants from Hargita, Qoxama Wichararo, and Hombancho perceived that watershed management in their communities has contributed to a reduction in soil erosion by 80%, 75%, 83% and 69%, respectively. This indicates that, their farm lands including settlement were strongly affected by frequent erosion and soil loss prior to watershed management. Thus, an increased vulnerability to drought and food insecurity in the study area was directly linked to the degraded conditions of the watershed and their effects on limiting its capacity to support local livelihoods.

Currently, due to watershed management interventions through community mobilization an area exhibited multiple positive effects on people's livelihoods improvement and environment. In line with this, 96% of the households were stated that soil erosion was reduced after the intervention/watershed treatment. Beside 72.9% of the households estimated the change as moderate and the remaining 27.1% were estimated the change as Very good. Thus, any increase in productivity through better soil health and fertility will serve to improve community livelihood on agricultural productivity. This result is also parallel with Zhou (2008), which stated the effect of vegetation cover on soil erosion in a mountainous watershed in China showed that greater vegetation cover can considerably decrease the loss of soil erosion.

Fig. 5. Part of the watershed which were put under ex-closure.

Increased in ground water table, soil moisture and spring capacity in watershed areas are an important measurable among various factors. Soil bunds, stone bunds, hillside terraces and other in-situ water retention structures (eyebrow basin, micro basin and trenches) were widely implemented in the study area. Increased in surface water or stream flow is another indicator that can help establishing positive impact of watershed development programmes on physical factors. Better infiltration was contributing to the recharge of local groundwater showed by a subsequent increase in the number of springs and much longer periods of base flow in the watercourses, offering new opportunities for irrigation for the farming communities in the lower part of the watershed to improve community livelihood. In view of these, 88%, 83% and 96% of the households were stated that they were observed change in soil moisture retention, ground water table from wells dug by villagers and capacity of spring after implementation of watershed development interventions, respectively. This improvements in soil moisture storage, the reduction of the erosive capacity of runoff and all options that help storing water, either in ponds, small reservoirs or in the ground were encouraged the adaptability of the farmers to climate change and variability to improve their livelihood.

Handosha watershed is well known by watershed treatments especially by soil bunds. These bunds contributed a significant role by reducing soil erosion and improving moisture retention.

The household survey indicated that watershed treatment by physical soil and water conservation structure reduced soil erosion problem in sloppy farm lands and yields some desirable effect on conserved soil which in turn improved the productive capacity of the land (Fig. 6). This survey results also confirmed that, 84.7% and 75% of the households were observed improvement in soil fertility and crop yield respectively, on their farm land after watershed treatment by soil bund. The households and also key informants related this change with increased in residual moisture content, decreased in soil erosion and for this reason protection of fertile top soil and ground water has been increased. These indicated that watershed management interventions in the study area provided significant change by reducing runoff and soil erosion, improving basin hydrology, maintaining and/or improving farmland soil fertility and thereby improving/maintaining agricultural production, reducing sediment load to natural and human made reservoirs and reducing further degradation.

Fig. 6. Part of the watershed under physical and biological measures.

Similar to this result, observed increase in crop productivity in handosha watershed as the result of implementation of watershed management also found that watershed interventions increased significantly the additional net returns from crop production as compared with the pre-watershed intervention period. Integrated watershed management approach enabled farmers to diversify the system along with increasing agriculture productivity through increased water availability, while conserving the natural resource base. Furthermore, households explained an increase in productivity of all major crops after watershed management intervention in the study area. Their incomes increased considerably, leading to improved living and building of the community livelihood and natural resources after intervention also indicated the watershed program significantly improved the socio-economic status of the watershed community. Furthermore, 60% of the respondents also specified that due to implementation of watershed management practices, sub-watershed investment funds from the sale of produce specially forage were improved. All of households (100%) stated that their knowledge about natural resource utilization, social relationship and habits of working in groups were improved after participation on community mobilization for integrated watershed management activities. The summarized result of focus group discussion and key informants indicated that the conflicts among communities over natural resource were reduced. Prior to watershed management there were strong conflicts between upstream and downstream users for land, forest and water because of the limited access of poor people to these resources. Currently, due to hydrological interlinked of upstream and downstream pressure on these resources were reduced.

Challenges of sustaining of watershed management

According to the data from the group discussants and interviewees, the implementations of integrated watershed management practices were faced with social, economic and natural challenges. This is in line with finding of Tesfaye *et al.* (2014) have indicated a relatively low level of success and weak evaluation in terms of environmental, socio-economic and cultural point of view. An interview was undertaken with one watershed management program team leader as follows: Physical and biological methods implemented through community lack continuation and integration to use for the long period of time. For example, in the field survey i observed that during the growing period different physical soil and water conservation structures such as the soil bunds constructed across farmland were destroyed by the owner due to shortage of land and less awareness and extension services of its long-term significance. This is rooted in a lack of sense of ownership and preference for involvement that offer short-term benefits (Key informants and integrated watershed management team leader opinion, January 2021). Furthermore, major challenges in the integrated watershed management were lack of integration in resource management, disagreement between the households and local leaders, unwillingness of youngsters to participate in conservation practices due to landlessness, climate variability, lack of follow up, lack of knowledge and means of utilizing the available resource, low skill of using technologies and inefficient organizational structure, poor institutional coordination. Considerable proportion of farmers indicated that shortage of land and soil erosion, bare and steeply topography were the major challenges

Farmers with small farm land were not volunteers to implement soil and water conservation practices since their farmland size was too small to apply different type's technologies. Another challenge in the implementation of the watershed was lack of awareness of households in the intervention. Similarly, lack of integration between sectors is also main challenge in integrated watershed management practices. Sometimes programs are overlapped. Moreover, lack of technology, information and skills, infrastructure were also affects the integrated watershed management implementation.

According to the field survey, low community participation in decision making is another problem. The factors affecting perception, participation and acceptance determine the sustainable utilization of the measures by the farmers (Amsalu and de Graaff 2006; Kessler, 2006). As indicated in this study lack of effective and genuine community participation in watershed management and consequent low adoption in most watershed management practices affected the sustainable enhancement environmental management practices and peoples' livelihoods. In addition a review reports from focus group discussion and interview indicated lack of continues extension services in general and training on watershed management practices in particular, lack of incentives like availability of credit services were challenges mentioned.

Involving community during planning, an implementation and operation phase of the plan helps to create the sense of ownership to ensure the sustainability of the integrated watershed management. Similarly observation is reported by Bekele and Drage, 2003 claimed that the watershed management program in the country did not succeed in triggering voluntary participation and acceptance of conservation practices. Literatures also indicated the challenges of sustaining watershed management practices such as lack of farmers' perception of soil erosion, participation and adoptions of conservation technologies and poor extension approaches (Amsalu and de Graaff 2006; Sileshi *et al.,* 2019), land tenure insecurity, the inability to make watershed conservation productive and high cost demanding of interventions (Bewket, 2007) and uniform application of similar watershed conservation measures disregarded agro-ecological variations (Ali and Surur, 2012).

An interview was undertaken with chairman of kebele administration and development agent as follows: In my opinion, various factors, such as lack of finance, working materials and lack of training were the major challenges households faced in participating in watershed management practices, such as, terracing. Furthermore, lack of technical knowledge and skills of households and fearing of consuming scarce farmland were the major obstacles in construction of physical structures, such as terraces. Farmers also interested in short-term agricultural production benefits than investments.

Conclusions

This paper was focused on the role of participatory watershed management practices for sustainable rural livelihood improvement of Handosha watershed Gibe district, Southern Ethiopia by using the data collected from 122 households randomly selected. The Gibe District together with NGOs and local communities carry out many activities in the study area to improve livelihood of the rural communities through community base watershed management practices, such as; Physical soil and water conservation measures, compost preparation, forestations, closure area protection activities. Moreover, conserving and promoting of high yield local crop varieties, not only yield but also disease resistance, crop rotation, conserving indigenous forests species and awareness rising to conserve natural resources. The different interventions were enabled to improve crop productivity, food availability, water status, livelihood diversification, income, employment opportunity, rehabilitation of degraded lands and reduction in migration in turn improved community livelihood in the study area.

Furthermore, the impacts of main watershed related problems, occurring in the study area i.e., productivity loss due to change in soil fertility, change in moisture retention**,** change in soil erosion, change in vegetation cover were generalized as less sever after watershed intervention. However, in the implementation of such activities some challenges were facing such as shortage of land and natural rainfall variability, lack of follow up, lack of knowledge and means of utilizing the available resource, water scarcity, and low skill of using agricultural technologies and inputs, lack of integration between development agents and experts. The cumulative values of overall livelihood asset were better after watershed intervention than before watershed intervention.

The study also empirically showed that watershed management program has a significant contribution in increasing rural livelihood assets. But, as the t-test result showed, older of household, larger farm land, larger family members, and training in relation to watershed managements have positive contribution for the acceptance of watershed conservation measures after intervention and Chi-square test results showed, crop diversification, food availability, land productivity were increased after watershed management intervention in the study area Hence, it can be concluded that, watershed management practice is crucial in improving the livelihoods of the local communities. This indicates an encouraging indication for participatory watershed management program designers and implementers to address the sustainable watershed development objective such as, soil productivity improvement, poverty reduction, improving ecosystem services and improving local community sustainable livelihoods. The study results have shown important policy implications: First, though there were hopeful improvements in the livelihood asset of households, there is space to enhance the livelihood assets of the communities while ensuring the sustainable management of natural resources. For example, many efforts needed to enhance the financial, physical and social assets to support rural livelihood benefits and long-term sustainability of natural resources. Second, the watershed management practices could be extended and up scaled to all areas, so that the participants in watershed management activities have got opportunity to improve their livelihood assets. Policy makers and development practitioners have to focus on the abovementioned factors of watershed management activities.

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